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Could A Robot Have A Subjective Point Of View?[1]

Abstract: *Scepticism about the possibility of machine consciousness comes in at least two forms. Some argue that our neurobiology is special, and only something sharing our neurobiology could be a subject of experience. Others argue that a machine couldn't be anything else but a zombie: there could never be something it is like to be a machine. I advance a dynamic sensorimotor account of consciousness which argues against both these varieties of scepticism.*

1. Introduction

The idea that there could be conscious robots will strike many as an obvious contradiction. We can just about make sense of an intelligent robot that can behave just like we behave. However the idea that a robot could enjoy a subjective mental life seems obviously mistaken. Surely any robot, no matter how much it resembles us functionally, must turn out to be a zombie, a mere machine entirely lacking in conscious experience. Indeed when we imagine a zombie, aren't we imagining a creature whose existence is much like that of a robot? We imagine something that makes all the right moves and produces all the right noises even though all is dark within: the machine has no inner mental life.

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Compelling though these intuitions are, I will argue that they may be groundless. My aim in this paper will be to describe some conditions a creature must satisfy if it is to enjoy a subjective point of view. If I am right, these are conditions a machine could very well satisfy. I admit that this is a conclusion which challenges our commonsense understanding both of consciousness and of machines. Part of my aim in this paper will be to persuade sceptics that they may need to rethink these assumptions.

I will argue that a dynamic sensorimotor (DSM) account of conscious experience can help us to see how it might be possible for a machine to have a subjective point of view. According to the DSM account, conscious experience is an activity of perceptually exploring the world in which one exercises one's sensorimotor knowledge. Sensorimotor knowledge is a form of practical knowledge where what the subject has mastery of are the dynamics which govern sensorimotor behaviour. Sensorimotor dynamics consist of laws or regularities which relate changes in sensory input to changes in motor output, and to changes in environmental conditions more generally. As an example, consider how, as we move our eyes along a straight horizontal line, the sensory input our visual system receives will be invariant (O'Regan & Noë, 2001, pp. 941–2). The self-similarity of a straight horizontal line will give rise to an unvarying pattern of sensory input. If we were to move our head up or down whilst tracking along the straight line and keeping our eyes in the same position, the head movement would have the consequence that our eyes are no longer in contact with the straight line, and this would bring about a change in sensory input. This is just one example of the sorts of regularities the implicit knowledge of which we draw on in experiencing the world.

The DSM account claims that it is exercise of sensorimotor knowledge which is constitutive of conscious experience. (See Hurley (1998) and Noë (2004) for two different versions of this view.) If this is right, a creature could enjoy conscious experience just by exercising its mastery of sensorimotor dynamics in actively sensing the world. It doesn't matter what the creature is made from because it is possession of sensorimotor knowledge that is necessary and sufficient for the having of conscious experience. The brain may be what realizes the exercise of sensorimotor knowledge in us but it is not obvious that this work couldn't be done by some other kind of non-neural substrate. Something without a brain — say a machine — could enjoy conscious experience just through the possession and exercise of sensorimotor knowledge.

Alva Noë, a prominent exponent of the DSM account, flatly rejects the possibility of machine consciousness: 'Who or what is it', he asks, 'that could notice the way patterns of "sensory" stimulation vary as a function of movement? And in the absence of a unified subject, how can we hope to have explained consciousness?' (Noë, 2004, p. 230). Noë's reason for rejecting the possibility of machine consciousness seems to be based on his reluctance to attribute subjectivity to a machine. Reading between the lines, his reasoning might be that whatever sensorimotor knowledge we attribute to a machine will exist only for us as observers of the machine. It won't be knowledge *for* the machine because the machine isn't a subject of experience.

Evan Thompson (2005, pp. 417–18) has expressed a similar worry in discussing O'Regan and Noë's example of a missile-guidance system. He says that sensorimotor knowledge seems to be:

> . . . merely attributed to the system by the observer, not original to the system itself. There is no genuine sensorimotor knowledge or mastery in this system because the system is not autonomous . . . It is not a self-producing and self-maintaining system that actively regulates its own boundary conditions so as to ensure its continued viability.

I will argue that *pace* Noë and Thompson, a machine could have what it takes to be a subject of experience. This I will do by arguing that the exercise of sensorimotor knowledge brings with it a kind of *self-awareness*. If a machine could acquire mastery of sensorimotor knowledge and exercise this mastery in sensing the world, it would be self-aware. It would have its own subjective point of view on the world by virtue of being self-aware.

2. Is the Brain Necessary and Sufficient for Conscious Experience?

Consider Tactile Visual Sensory Substitution Systems (henceforth 'TVSS'). In a number of extraordinary studies Bach-y-Rita has shown that subjects who have become blind can use data supplied by TVSS to 'see'.[2] Crucially the transformation of tactile perception into 'visual' experience depends on the subject's being in control of the

[2] In TVSS, optical images picked up by a head-mounted camera are transduced so as to activate an array of stimulators (vibrators or electrodes) in contact with the subject's skin (attached to the abdomen, back, thigh and more recently to the tongue). After a period of training, subjects who have been in control of the head-mounted camera report having experiences of objects in three-dimensional space. In other studies Bach-y-Rita and his colleagues have shown that sensors can replace other lost sensory information such as sound and balance so as to produce auditory and vestibular substitution. See Bach-y-Rita & Kercel (2003) for an overview.

camera. If the camera is stationary or if someone else controls it, patients report feeling only tactile sensations. Why should being in control of the camera make so much difference? The tactile sensations transduced by TVSS in the inactive subjects are transmitted to the somatosensory cortex just as in the active subjects. However, in the active subjects this activity in the somatosensory cortex realizes an experience of a distinctively visual character. What explains the somatosensory cortex coming to implement this new role in active subjects but not in inactive subjects?

O'Regan and Noë (2001) have hypothesized that subjects who have control of the camera are able to pick up on patterns of dependency that hold between the movements they make and what they perceive — what I have called the 'sensorimotor dynamics' governing TVSS-seeing. For example, as the subjects move around an object, hidden portions of it come into the camera's view. As the subjects move closer to an object, the image captured in the camera will also get larger and the opposite will happen as they move away from an object. Subjects cannot become attuned to these sensorimotor dynamics if they are not in control of the camera. This is why the tactile information supplied by TVSS isn't transformed into visual information for them. Hurley and Noë (2003, p. 145) explain:

> What it is like to see is similar to what it is like to perceive by TVSS because seeing and TVSS-perception are similar ways of exploring the environment: they are governed by similar sensorimotor constraints, draw on similar sensorimotor skills, and are directed toward similar visual properties, including perspectivally available occlusion properties such as apparent size and shape.

What TVSS does is reroute the inputs normally handled by the visual system via tactile stimulation. Subjects adapt to this rerouting when they acquire mastery of the new sensorimotor dynamics governing TVSS-seeing. Subjects must have acquired the necessary sensorimotor know-how before they can use TVSS to see.

The brain might be necessary for experience in TVSS perceivers, but it doesn't appear to be *sufficient*. Neural activity can work in conjunction with TVSS to realize visual experience only once subjects have acquired sensorimotor knowledge. Neural activity and TVSS are not on their own sufficient for visual experience. This is shown by the inactive subjects that fail to adapt to the rerouting of visual information. The activity in the somatosensory cortex of inactive subjects doesn't suffice for conscious visual experiences because they haven't acquired the necessary sensorimotor know-how.

Someone might resist this conclusion by arguing that a subject acquires mastery of sensorimotor knowledge just when their brain becomes attuned to sensorimotor dynamics.[3] Once a brain is tuned to the relevant dynamics, perhaps we can say then that neural routines are sufficient for conscious experience. We could even explain well the difference in performance between active and inactive TVSS subjects using this hypothesis. Inactive TVSS subjects report no visual phenomenology because their brains have not become attuned to sensorimotor dynamics characteristic of TVSS-seeing. This proposal can accept that it is the acquisition of sensorimotor knowledge that explains how subjects are able to represent visual properties using TVSS. However, once the sensorimotor knowledge has been acquired it says that there will now be neural routines in these subjects that suffice for conscious experience of visual properties.

For my purposes it doesn't matter much which of these two accounts is correct. The role that has been given to sensorimotor knowledge by both accounts presents a challenge to a view that takes the brain to be *necessary* for experience. On both views, it is the acquisition of sensorimotor knowledge that does the work of explaining how a subject comes to enjoy experiences with distinctively visual phenomenology, not the neural activity realizing those experiences. This raises the possibility that it is the possession of sensorimotor knowledge that is necessary for subjective experience, not the neural activity that happens to implement the exercise of sensorimotor knowledge in us.

The first view sketched above claimed that neural activity may not always be sufficient for conscious experience. Perhaps the brain can implement conscious experience only when subjects are in possession of the necessary sensorimotor knowledge. There is nothing special about our biological wetware. The work of physically implementing the exercise of sensorimotor knowledge could be done by a system made from different materials. On the second view, sensorimotor knowledge only explains how the brain comes to code for sensory features. Nothing precludes telling the same sort of story about a machine: a machine could come to occupy states that code for sensory features by acquiring the relevant sensorimotor knowledge. If this is right, it doesn't much matter what a system is made from when it comes to determining whether it has a subjective point of view or not. Part of what matters (perhaps all that matters) is that the system has

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[3] Thanks to Andy Clark for this objection. See Clark (2006, p. 10) for a sketch of the account described here.

the right kinds of sensorimotor knowledge. What is required is that the machine understand the patterns of dependency that hold between sensory stimulation and movement. Providing the machine has these abilities, it will have what it takes to undergo qualitative experience.

3. When is a Creature a Subject of Experience?

The possession of sensorimotor knowledge may be necessary for enjoying conscious experience, but is it also sufficient? Couldn't a machine possess sensorimotor knowledge but there be nothing it is like for the machine to sense the world? We have already encountered this objection in my introduction. There we saw Alva Noë and Evan Thompson both raise the worry that sensorimotor knowledge wouldn't be knowledge *for* the machine. Noë worried that the machine would not be a unified subject that could notice the way its sensory input changes with its movement over time. The remainder of my paper will argue that a machine could be a unified subject. In what remains of this section I will sketch an account of what I take to be required for a system to qualify as a subject of experience. The account I will give will be at best provisional, requiring a more detailed defence than I can provide in this paper. Nevertheless what I have to say here will suffice to show that subjectivity comes more or less for free in creatures that can acquire and exercise a mastery of sensorimotor knowledge. At least this is what I shall argue in my closing section.[4]

To be a subject of experience is to have a first-person perspective or point of view on the world. I have my own first-person point of view on the world, a point of view which is *first-person* because I have a kind of direct and immediate access to whatever is available from this point of view that you lack. Moreover, my point of view is indexed to me and not to you. You cannot occupy my point of view: the point of view you occupy will always be your own — it will be indexed on you and not on me. If I want to know what your point of view is like, I have to try to imagine that the experiences I am having are not mine but are yours. I have to try to imagine that I occupy your point of view.

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[4] For different attempts to defend the hypothesis that the exercise of sensorimotor knowledge suffices for conscious experience with which I am in broad sympathy, see O'Regan & Noë (2001); Myin & O'Regan (2002); and O'Regan, Myin & Noë (2004). Still the intuition persists that a creature could exercise sensorimotor knowledge and yet there fail to be anything it is like to be this creature. Someone might be willing to concede the connection between the exercise of sensorimotor knowledge and being a unified subject but deny that a system that exercised sensorimotor knowledge was enjoying anything in the way of experience. There is a difference between being a unified subject and being a unified subject of experience (my thanks to Steve Torrance for pressing this objection). I will return to this worry in my concluding comments.

Representations that are produced from a point of view are 'location dependent representations' (LDRs). LDRs are from a point of view because they have contents which are indexed to locations: the particular spatial and causal point of origin from which they have been produced. The content of a LDR will vary with the location from which it has been produced. As you move about and your location changes, so does what you experience: the contents of your experience. To offer just one example, some objects which had previously been occluded may come into view while others which had previously been in your field of view may become hidden. Which objects are occluded and which are in view will be determined by the location from which your representation is produced.

What is it for a point of view to be a subjective or *first-person* point of view? To say that a point of view is *first-person* is to capture the sort of epistemic access enjoyed by the creature which occupies a particular point of view. Consider as an example pain experience: my pain experiences are knowable in a direct and immediate way by me. Perhaps others can know my pain in this way too by perceiving behaviour which is expressive of my pain experience. This possibility to one side, it is arguably the case that my pain experiences are knowable in this first-person way because they are given as mine:

> When I (in nonpathological standard cases) am aware of an occurrent pain, perception or thought from the first-person perspective, the experience in question is given immediately, noninferentially and noncriterially as mine . . . Whether a certain experience is experienced as mine or not, however depends not on something apart from the experience, but precisely on the givenness of the experience. If the experience is given in a first-person mode of presentation it is experienced as my experience. (Zahavi, 2006, p. 124)

We normally think of objects and their properties as what is 'given' in experience. I taste the sourness of the lemon; the sour lemon is what is given in my experience. Zahavi is suggesting in this passage that the experiences themselves, not just what they represent, have the property of givenness. It is this property which, I am suggesting, accounts for an experience being knowable in a first-person way. It is because my experiences are given as mine that I can have this special kind of access to them. Similarly, you can know your experiences in this first person way (immediately and directly) because your experiences are given as belonging to you.

This givenness, which is a feature of our experiences and which makes them accessible in a first-person way, is the result of a kind of self-awareness experiences have built into them. To see this, consider how there are many mistakes I can make about my experiences, but the one thing I cannot be mistaken about is whether an experience is mine or not. If I am feeling a pain or seeing a sunrise it doesn't make sense for me to doubt that the pain I am feeling is my pain or the visual experience I am undergoing is my visual experience.[5] The reason these kinds of doubts don't make sense is because I am somehow aware of my experiences as being mine: I am aware of myself as their owner or subject. I don't need to first identify myself and then judge that I am the subject of the experiences in question. Knowledge arrived at in a first-person way is, to borrow a term from Evans (1982, pp. 181–2), 'identification-free'.[6] The knowledge I have of my experiences is identification-free because, built into my conscious experiences, is an awareness of them as belonging to me.

If the analysis of this section is along the right lines, the challenge of showing that a machine could have a subjective point of view is actually the challenge of showing that a machine could enjoy a primitive kind of self-consciousness. The kind of self-consciousness that is required isn't a sophisticated conceptual kind of self-consciousness of the sort adult humans possess when they can think about themselves over time. It is a primitive non-conceptual variety of self-consciousness (see Hurley, 1998, ch. 4; Thompson, 2005; Legrand, 2006; Zahavi, 2006) in virtue of which a subject has first-person access to its experiences. In the next section I will argue that a machine which could acquire sensorimotor knowledge would also have what it takes for self-awareness. By virtue of this self-awareness it would also qualify as having its own subjective point of view.

4. Machine Self-Consciousness

Let us begin by returning to our earlier conclusion (Section 1) that possession of 'sensorimotor knowledge' is a necessary condition for enjoying conscious experiences. There it was argued that it may not matter what a creature is made from when it comes to determining whether that creature is conscious. What matters is instead that it be in possession of sensorimotor knowledge. We use our sensorimotor knowledge to form *expectations* about the likely effects of our movement, or movement in the world, on our sensory input. It is being able

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[5] Shoemaker (1968) labels this phenomena 'immunity to error through misidentification relative to the first person pronoun'.

[6] Evans calls knowledge of a singular proposition 'a is F' 'identification-dependent' if this knowledge has been arrived at by inference from a pair of propositions 'b is F' and 'a=b'. Knowledge is 'identification-free' if it is not identification dependent.

to form correct expectations of this sort that enables one to experience the presence of a whole object, say an apple, when what one is sensing of the apple at a particular time is only a partial and incomplete profile. The hidden parts of the apple are present in one's experience because one has expectations about what one would see of the apple were one to vary, through movement, one's spatial relations with the apple. In a similar fashion one can experience an object's constant shape, size or colour despite variations in one's experience because of one's sensorimotor expectations. An object will look smaller when seen from a distance and will look larger as one moves closer. Yet across these different experiences, one experiences an object of the same size. One experiences the true size of the object through changing experiences because one has correct expectations about how objects of this size look with variations in distance.[7] The expectations we form based on our sensorimotor knowledge thus play a crucial role in fixing the content and character of our experience.

To exercise sensorimotor knowledge is, in part, to form expectations of this kind. In the course of acquiring sensorimotor knowledge we come to associate changes in sensory input with movements we make. We come to associate rapid movement towards an object with looming effects, for instance. We expect that if we move our head to the right, objects in the centre of our visual field will move to the left. We can think of these expectations as functioning in much the same way as forward models which predict the sensory consequences of movement.[8] These predictions can also be used to fine-tune behaviour. Instead of using actual feedback to fine-tune behaviour, our motor systems can use simulated feedback in the form of forward models to fine-tune behaviour as it unfolds.

I want to suggest that a system which can acquire knowledge of sensorimotor dynamics must have a means of comparing the predictions it forms about sensorimotor dynamics with its actual sensory input. It is only if it has such a monitoring mechanism which it can use to compare its expectations with actual input, that it will be able to modify its false expectations. It must be able to correct for any false expectations it has formed in the past if it is to succeed in acquiring mastery of the sensorimotor dynamics which characterize the different objects of its experience. By correcting for false expectations a creature will be fine-tuning its sensorimotor knowledge, acquiring

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[7] Here I am following the account of perceptual constancies defended in Noë (2004), chs. 3 and 4; and Noë (forthcoming).

[8] For more on the notion of a forward model see Rick Grush's (2004) emulation account of representation. Also see Frith *et al.* (2000).

knowledge of a richer variety of sensorimotor dynamics. Thus we can conclude that a system that is able to acquire sensorimotor knowledge through learning must have a monitoring mechanism for comparing actual sensory input with predicted sensory input. I will argue next that this monitoring mechanism is the key to generating the kind of givenness which is the defining characteristic of subjective experience.

According to the DSM account, conscious experience is an activity of exploring the environment in which the senses are used to repeatedly probe the world through bodily movement. The DSM account claims that there will typically be three elements involved in sense experience: (1) intentions to move or motor intentions; (2) predictions about the motor and sensory consequences of movement; (3) actual sensory input, including proprioception. Now suppose that a monitoring mechanism was continuously comparing these three elements, delivering a match between motor intentions, proprioceptive and other sensory input, and our actual movements. When these three elements match or cohere, the resulting experience will feel like one's own experience. It will be *given* as one's own.[9]

We are now in a position to draw an initial conclusion. According to the sensorimotor dynamic theory, experiences will typically include the three elements described above. I've argued that if a system is to acquire sensorimotor knowledge, it must be equipped with a monitoring mechanism which is continuously comparing predicted and actual sensory input. We can conclude that whenever the monitoring mechanism finds a match or coherence, the resulting experience will feel like the subject's own experience. It will have the peculiar givenness which it was argued gives our experiences their subjective character.

In the previous section I argued that this property of givenness was the result of a kind of self-awareness which is built into our experiences. I have just suggested that the result of a match between predicted and actual sensory input will be experiences that have this property of givenness. I am suggesting then that what this simple monitoring mechanism delivers is a kind of self-awareness.

At this point I would like to back-track on this claim slightly. The detection of a match between these three kinds of information (motor intentions, expectations and sensory input) does strike me as an important, probably necessary, ingredient in self-awareness. However I am not convinced that it is a sufficient ingredient. A representation might be *given* as the system's own representation when its comparator mechanism found a match between these three kinds of information.

[9] I am indebted here to Legrand's (2006) account of bodily self-awareness.

Still it might be objected that the representation wouldn't *feel* like anything for the system unless the system was also a subject of experience.[10]

When a match is detected by the comparator mechanism the result will be a coherence of sensory input and motor output. In order for coherence of this kind to generate a variety of self-awareness it must give rise to what I shall call *subject unity*. Distinct representations R_1 and R_2 are subject unified if the subject is co-conscious of R_1 and R_2 together as both standing in the relation of belonging to that subject. Detecting a match between a motor intention, expectations and actual sensory input will certainly generate a kind of unity. What is detected is that these three sorts of information relate to one and the same body. However this unity will only count as subject unity if each element — the motor intention, the expectation and the sensory input — is itself conscious. If this requirement is not met, just detecting a match between these three types of information will not generate subject unity and so will not generate self-consciousness.

I will follow Hurley (1998) in claiming that what does the additional work in generating consciousness is *agency*. The motor intention the subject forms — the intention to perform certain actions — must be selected by the system because it is a means to achieving the system's ends. Moreover the system must have access to the information carried by its representations such that it can make use of this information in reasoning and planning, and in particular in forming motor intentions. The monitoring mechanism is not on its own sufficient for self-awareness. It is the availability of information and the use of this information in means-end reasoning that makes the information in question conscious. It is the rational relations between experience, intention and action that yield the kinds of connections between representations required for subject unity.

It seems to me undeniable that we could build a machine that could acquire knowledge of sensorimotor dynamics using a monitoring mechanism of the kind described above. It doesn't seem to me out of the question that we could build a machine capable of means-end reasoning. Such a machine would have to have its own purposes and goals which it behaved to bring about. Moreover it would have to be capable of figuring out strategies for achieving those goals. The project of building such a machine has always been the goal of artificial intelligence. I conclude then that if we could build a machine capable of acquiring and exercising sensorimotor knowledge, and if that machine

[10] Thanks to Steve Torrance for raising this objection.

was capable of means-end reasoning, it would have its own subjective point of view.

It has been objected that the possession of sensorimotor knowledge is insufficient for conscious experience since a machine couldn't be a unified subject of experience. I have argued that if a system were continually finding a match between the predictions it made about the sensory consequences of its movement and its actual sensory input, such a system would have 'experiences' that 'felt' like its own. I have argued that it is this feeling of givenness or mineness that is required for subjectivity. In response to the objection that a system could continually detect such a match but not feel anything, I've conceded that the system would need to be making active use of its experiences in pursuing its projects and goals in order for it to count as a unified *subject* and hence as a system that has genuine feelings and experiences. A system whose experiences were in this way integrated with its projects and goals would be a unified subject. I conclude then that a machine could have a subjective point of view by acquiring and exercising sensorimotor knowledge in the active pursuit of its projects and goals.

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